(TRANSLATION)

JAPANESE PATENT OFFICE

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TITLE OF THE INVENTION:
REINFORCEMENT FIBERS FOR CEMENT

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1. TITLE OF THE INVENTION:
REINFORCEMENT FIBERS FOR CEMENT

2. WHAT IS CLAIMED IS:

Reinforcement fibers for cement comprising organic fibers or inorganic fibers having a nonionic or cathionic polymer coagulating agent coated thereon.

3. DETAILED DESCRIPTION OF THE INVENTION:

A. TECHNICAL FIELD OF THE INVENTION:

This invention relates to reinforcement fibers to be used in cement. More particularly, this invention relates to reinforcement fibers whose surfaces are coated with a polymer coagulant, which are to be used in cement to excellently improve the adherence of the interface with the cement matrix and the resistance against a bending force imposed on the cement product.

B. PRIOR ART AND PROBLEMS THEREOF:

Conventionally, asbestos cement plates are produced in manners similar to those in making paper. Hatcheck's method has been most popular for a long time. Asbestos fibers when used in cement are excellent in affinity for cement matrix. Asbestos fibers provide a strong unity and when long fibers and short fibers thereof are properly mixed, they greatly improve production efficiency, as well as provide a powerful reinforcement to the cement products.

However, as far as Japan is concerned, most of asbestos is imported, and therefore the price is unstable. What is

more, asbestos is regarded a dangerous substance now. Accordingly, demands for its substitutes are growingly strong. Glass, polyethylene, polypropylene, nylon, polyacrylic resin, vinylon, carbon fibers, alamide, alumina, etc. have been introduced.

The following features are required for usable reinforcement fibers:

1) Fine fibers (filaments) must not tangle with one another and must disperse uniformly in a cement liquid;

2) They must have a good affinity for cement and adhesion; and

3) They must possess a good durability and be alkali-proof.

The aforementioned fibers do not satisfy all the above requirements.

For instance, olefinic fibers, such as polyethylene fibers and polypropylene fibers, are hyrophobic and therefore they do not disperse well in a cement liquid. They are poor in affinity for cement matrix and unity. Nylon fibers and vinylon fibers are hydropholic and have a good affinity for cement, however, these do not provide a good unity. Glass fibers are poor in alkali-proof and do not provide a good unity. Alamide fibers and carbon fibers do not disperse in a cement liquid well and very poor in providing unity. In addition, they are expensive.

Various proposals have been made in order to solve the weaknesses of such fibers. For example, fibers are treated to have wrincles on the surface or treated with a surfactant

to improve their unity with cement matrix, or they are covered with another substance to improve their resistance against alkali.

It can be expected that the adherance between fibers and cement particles in a cement plate will improve to some degree by using some of the above-mentioned treatments, however, adherance between fibers and cement slurry can not be expected to improve satisfactorily, and no satisfactory methods have yet to be found to produce good quality cement plates out of such slurry using a method similat to a paper making method.

It is important that cement particles stably stick to the surface of fibers in abundance and the fibers are dispersed uniformly in the cement slurry to produce good quality cement plates in manners like those utilized in making paper, and that the above conditions should be held all through the production processes, however, conventionally, cement slurry containing any of the aforementioned fibers does not possess a good enough adhesion between the fibers and the cement particles and therefore good enough quality cement plates cannot be expected to be manufactured.

C. OBJECT OF THE INVENTION:

Accordingly, the object of the present invention is to provide cement reinforcement fibers which replace asbestos fibers for using in cement slurry for production of good quality cement plates.

D. COMPONENTS OF THE INVENTION FIBERS:

The above described object can be attained by providing

organic or inorganic fibers whose surfaces are covered with a nonionic polymer coagulant or cathionic polymer coagulant.

Organic or inorganic fibers usable for the present invention are of polyethylene, polypropylene, nylon, vinylon, rayon, polyacrylonitryl, glass, alamide, carbon, ceramics, etc. Synthetic acryl fibers are most preferable. Preferably, fibers used for the present invention are 0.5 - 10 d, over 120 g/d in elasticity, over 5 g/d in strength, more preferably over 6 g/d, and 0.5 - 15 mm in length. It is preferred that 0.5 to 5 wt.% of fibers are mixed in cement. Fibers less than said range do not provide a satisfactory reinforcement and fibers more that the range do not improve reinforcement much, either, since the dispersion is adversely affected. It is naturally possible to assistingly blend in the mixture some fibrillar pulp, acrylic fibrils, aromatic polyamide fibrils and/or asbestos fibrils. Cement matrixes to be used are Portland cement, alumina cement, slug cement, silica cement, ect.

Polymer coagulants to be used are polyacrylamide, polyethylene oxide, etc. as a nonionic coagulant, and polyalkyl amino crylate, metha-acrylate, aminoalkyl acrylate, copolymer of metha-acrylate and acrylamide, polyacrylamide mannich denaturants, polyethylene imine, polyamine, ring polymer of diarylammonium halides and copolymer with sulfur dioxide, polyvinyl imidazolin, water soluble aniline resin hudrochroride, copolymer of hexamethylene diamine-epichlorohydrine, etc. as a cathionic polymer coagulant. Most preferably, polyacrylamides, polyacrylates and polymetha-acrylates are used since these substances are alikali-proof and possess an excellent coagulation power.

The amount of such a coagulant on fibers is to be 0.05 -

1 wt.%, and most preferably 0.1 to 0.6 wt.%. Amounts less than the ranges cause poor adhesion between cement matrix and the fibers, and amounts more than the ranges badly affect the dispersion in cement slurry because adherance between the fibers themselves is caused.

Fibers are first submerged in an about 0.1 % water solution of a polymer coagulant and then dehydrated between dehydration rolls or by centrifugation. The fibers should not be excessively dried. If they are exessively dried, especially when the used polymer coagulant is a solid type, more time is required for resolving the coagulant again in water, badly affecting the dispersion of the fibers in cement slurry.

The present invention utilizes the coagulation power of such a polymer coagulant to obtain adhesion. That is, adhesion is obtained from attraction by neutralization of charges and bridging by polymer chains. Cement is usually cathionic in water. An anionic coagulant is mixed therein to form flock and the fibers and cement are adhered by causing adhesion and bridging between the cathionic or nonionic polymer coagulant on the fibers and the flock. It is therefore preferred that such polymer coagulants are cathionic, however, as bridging of polymer also works, nonionic coagulants can also be used. Anionic coagulants are not usable. Accordingly, the molecular chains of a coagulant for the present invention should be large enough, between 1,000,000 to 20,000,000, more preferably 3,000,000 to 15,000,000.

E. EFFECTS OF THE INVENTION:

Slurry where cement particles are stuck on fibers in a

large amount can be provided according to the present invention, said fibers having a strong adhesion and dispersed uniformly in the slurry, by mixing in water fibers on which a nonionic or cathionic coagulant is stuck and then adding a cement coagulant such as anionic polyacrylamide. This slurry is tough and hard enough and does not leak from a sheet net during the cement plate production processes, improving the production efficiency greatly. Thanks to the excellent dispersion of the fibers and adhesion, the product cement plates are very tough against bending.

In the following description, the present invention is more fully explained by using embodiments.

EMBODIMENTS 1 TO 3:

Three kinds of 0.1 % water solutions were prepared each containing a polymer coagulant as shown in Table 1. Synthetic acryl fibers were submerged in each solution for 5 minutes at room temperature. The fibers were dehydrated using a centrifugal method. The amount of the coagulants on the fibers was about 0.5 g wt.% each. The fibers were then cut without excessively drying into 5 mm in length. The cut fibers (10 g), craft pulp (10 g), $Ca(OH)_2$ (10 g) and $Al_2(SO_4)_3$ (10 g) were placed in water (10 l) and mixed. The mixtures prepared as auch were provided with Portland cement (460 g) each and mixed again. Then, a cement coagulant (200 ppm) of anionic polyacrylamide was mixed into each mixture while the mixtures were kept being mixed slowly. Three types of cement plates produced from the slurries prepared as such were tested for their bending resistances. Table 1 shows the result.

Study of Adhesion:

The slurries, each 0.2 l, were separated into more samples and mixed at 400 rpm for 5 min., 10 min. or 15 min. They were sent onto sheet nets. The solid substances on the sheet nets were partially dried at 105 degrees C, and the weights were measured to obtain the cement retention percentages.

Study of Effectiveness:

The slurries were placed on sheet nets moving at the speed of 150 cm/min. After partially drying at 105 degrees C, the solid substances on the sheet nets were measured for their weight.

Tests for Cement Plates Productivity and Bending:

The slurries were placed on sheet nets which are placed over moulds (20 cm × 25 cm). After drainage, the slurries were pressed for one minute and cement plates of about 6 mm thick were obtained. The fibers in the cements were 2 wt.%. They were kept for one day at 20 degrees C and 100 % RH, and were then put in water (20 degrees C) and kept there for six days. Samples were cut out from the cement plates and tested according to JIS-K-6911 for strength against bending.

COMPARISONS 1 TO 3:

The polymer coagulants and surfactants as shown in Table 1 were used and cement plates were prepared as described above. The same tests were conducted.

EMBODIMENTS 4 AND 5:

Cement plates were prepared using the coagulants of cathionic polyalkyl amino acrylate as shown in Table 2 in the same manners an above. The same tests were conducted.

Table 1 shows some of the results of the tests. As can be seen from the table, the fibers according to the present invention possess a great cement retention and productivity of cement plates. The cement plates made according to the present inventon showed excellent properties. Table 2 shows the similar results. On the other hands, the comparison cement plates showed poor properties.

TABLE 1

	COAGULANT/ SURFACTANT	ION	MOLECULAR WEIGHT	RETENTION wt.% MIX. TIME min.				SOLID WEIGHT	BEND RESIS.
				0	5	10	15	g/cm2	kg/cm2
EMBD. 1	polyalkyl amino acrylate	cathion	3 mil.	66	49	54	27	318	215
EMBD. 2	polyacryl amide mannich	cathion	7 mil.	68	51	32	28	320	212
EMBD. 3	polyaklyl amide	nonion	5 mil.	60	40	25	20	302	205
COMP. 1	polyaklyl amide partially hydrolyzed	anion	10 mil.	50	20	14	8	250	180
COMP. 2	dodecyl phenyl ether ethylene oxide	nonion	7 mil.	10	4	4	4	120	185
COMP. 3	acryl amide 4-ammonium salt	cathion	5 mil.	15	4	4	4	150	182

* Comparisons 2 & 3 use surfactants:
Others use polymer coagulants.

TABLE 2

	FIBERS	RETENTION wt.% MIXING TIME min.				BEND RESISTANCE kg/cm2
		0	5	10	15	
EMBD. 4	Alamide (Kepler)	58	42	31	24	31.5
EMBD. 5	Carbon	70	53	44	40	270

AMENDMENT

(1) In the specification:

Please change "0.05 ....., ...0.6 wt.%" to "0.01 to 1 wt.%, more preferably, 0.05 to 0.6 wt.%".

(2) In the specification:

(a Japanese typographycal error)

(3) In the specification:

Please change "0.5" to "0.1".

(4) In the specification:

(a Japanese typographycal error)

(5) In the specification:

Please change "7 mil." to "700".
Please change "5 mil." to "500".